

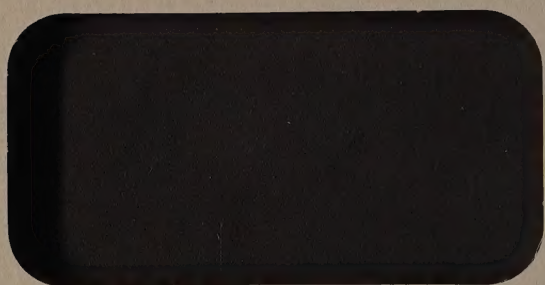
PRICE \$5.00



INSTRUCTION MANUAL



131-38 SANFORD AVE. • FLUSHING, N.Y. 1135
(212) 461-7000 • TWX # 710-582-2631





OVERVOLTAGE PROTECTORS

Model VP-KCA

Serial No. A-42524

INSTRUCTION MANUAL

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SECTION I - INTRODUCTION

1-1 SCOPE OF MANUAL

- 1-2 This instruction manual contains information about the operation, installation, and maintenance of the Kepco Series VP-KCA, VP-KS1 and VP-KS2 Overvoltage Protectors.

1-3 GENERAL DESCRIPTION

- 1-4 This Kepco Sales VP-KCA, VP-KS1 and VP-KS2 Overvoltage Protector are independently powered crowbar devices, designed to protect against overvoltages resulting from power supply failure. The sensing circuit of the overvoltage protector draws 0.1 mA from the power supply output. Any rise in power supply output voltage beyond the pre-set static trigger level of the VP will result in an immediate short circuit across the power supply output terminals (SCR crowbar) and in subsequent drop-out of the circuit breaker, located in the VP, which disconnects the power supply and the VP device from the power line. VP-KCA, VP-KS1 and VP-KS2 Overvoltage devices may be used with Kepco power supplies (see Table 1-1) or with other, similar power sources being able to sustain a short circuit across their output terminals.

1-5 SPECIFICATIONS, ELECTRICAL

- a) **STATIC TRIGGER LEVEL.** The operating or static trigger level may be set to as close as 5% or 0.25V (whichever is greater) of the power supply output voltage setting.
- b) **TEMPERATURE COEFFICIENT:** 0.1% or 0.1 volt (whichever is greater) per °C.
- c) **REMOTE ERROR SENSING.** Sensing connections, allowing remote sensing of the load are provided. Load wire voltage drops up to 1.0 volt per output lead can be compensated.
- d) **TRIGGERING TIME (adjustable delay)**
5 to 20 microseconds, with adjustable delay to minimize spurious triggering and reduce false alarm rate.
- e) **ALLOWABLE-FAULT TIME:** Infinite, VP-KCA, VP-KS1 and VP-KS2 Overvoltage Devices are protected by a built-in circuit breaker which removes AC power from the device (as well as from the connected power supply) within approximately 50 milliseconds after crowbaring has taken place.
- f) **OPERATING TEMPERATURE:** -20°C to +65°C.
- g) **STORAGE TEMPERATURE:** -40°C to +85°C.

OVERVOLTAGE PROTECTOR	FOR USE WITH KEPCO POWER SUPPLY MODEL	OPERATING RANGE
VP - KCA	ABC, CK, KS (EXCEPT AS LISTED BELOW)	3 - 160 volts
VP - KS1	KS 36-30(M), KS 60-20(M), KS 120-10(M)	3 - 160 volts
VP - KS2	KS 8-100(M), KS 18-50(M), KS 8-50(M)*	3 - 30 volts

*NOTE: AC Power Line-Plug on this model must be replaced with a 30A - "Hubble - Twist Lock" plug or equivalent.

TABLE 1-1 VP-K OVERVOLTAGE PROTECTORS

1-6 SPECIFICATIONS, PHYSICAL

Refer to Mechanical Outline Drawing, FIG. 1-2.

1-7 DEFINITIONS

1-8 The graphically explained definitions (FIG. 1-1) apply to all Kepco Overvoltage Protectors and will be used throughout this manual.

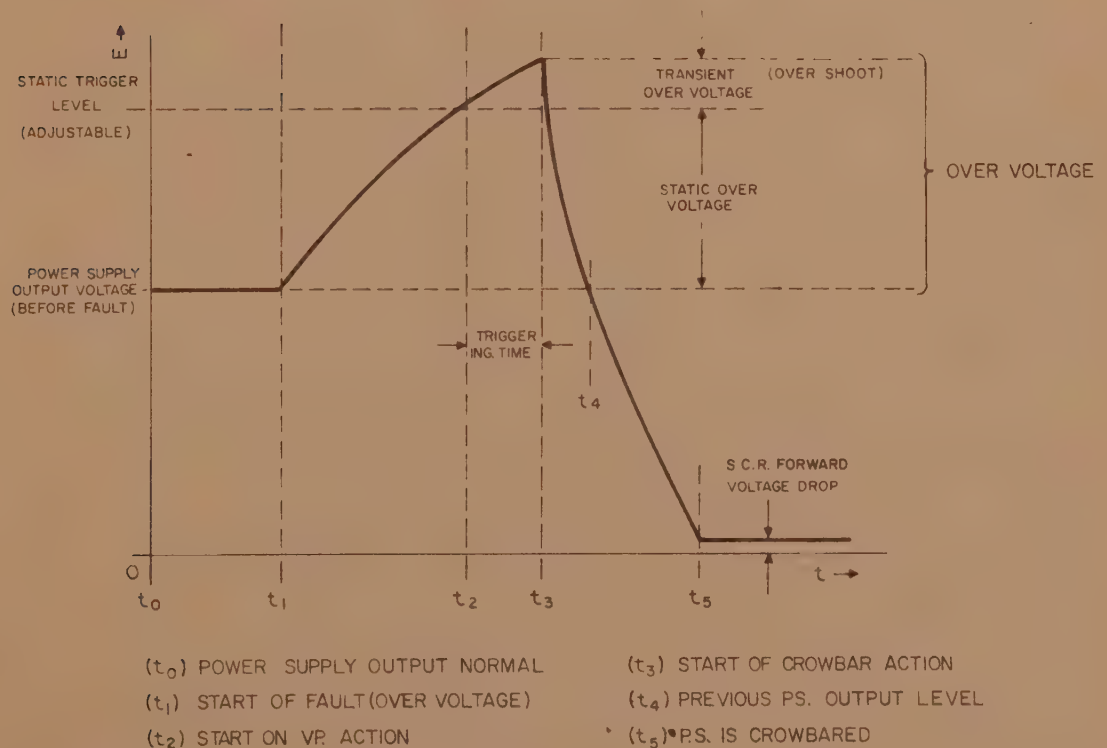


FIG. 1-1 KEPKO VP DEVICES, DEFINITIONS

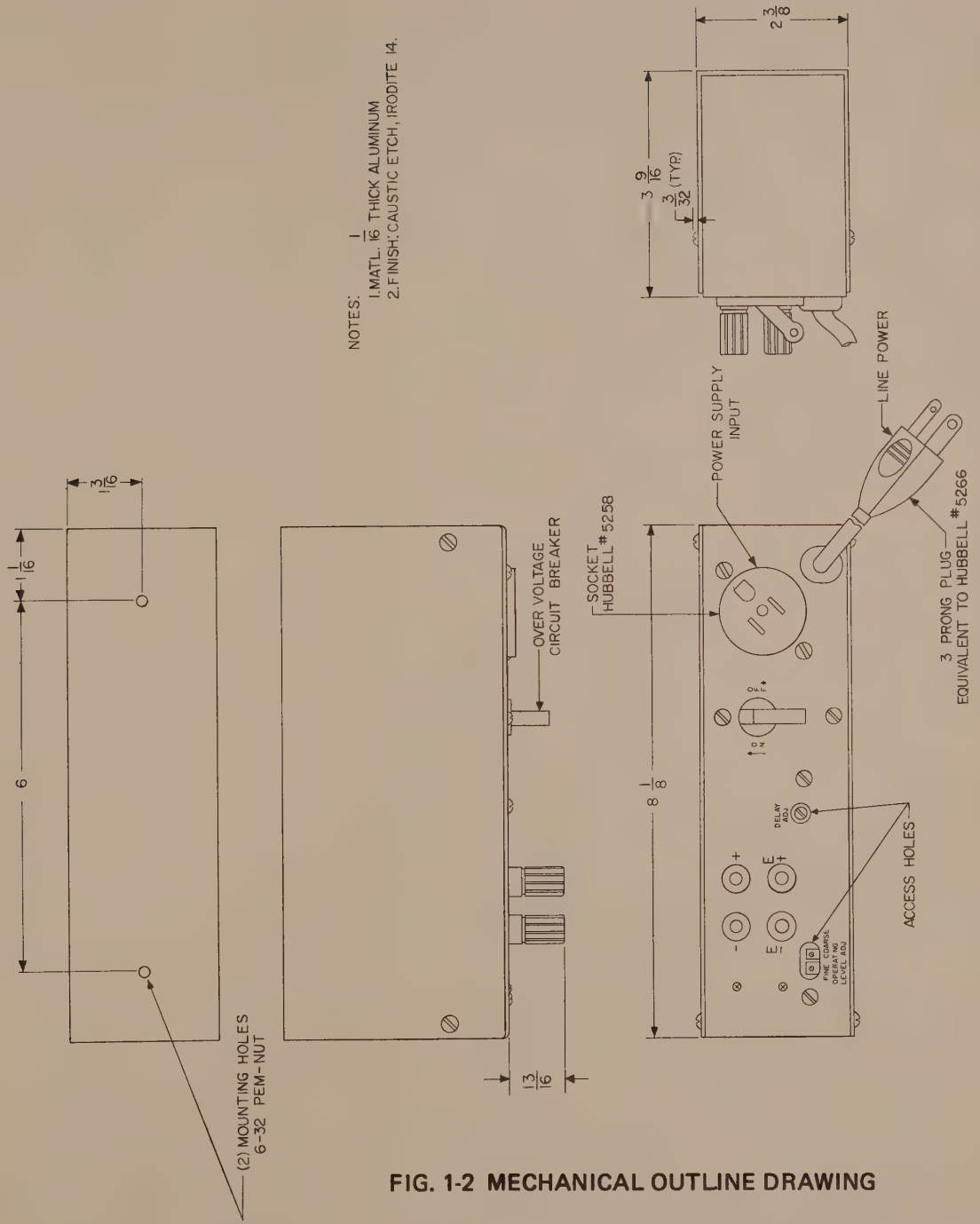


FIG. 1-2 MECHANICAL OUTLINE DRAWING

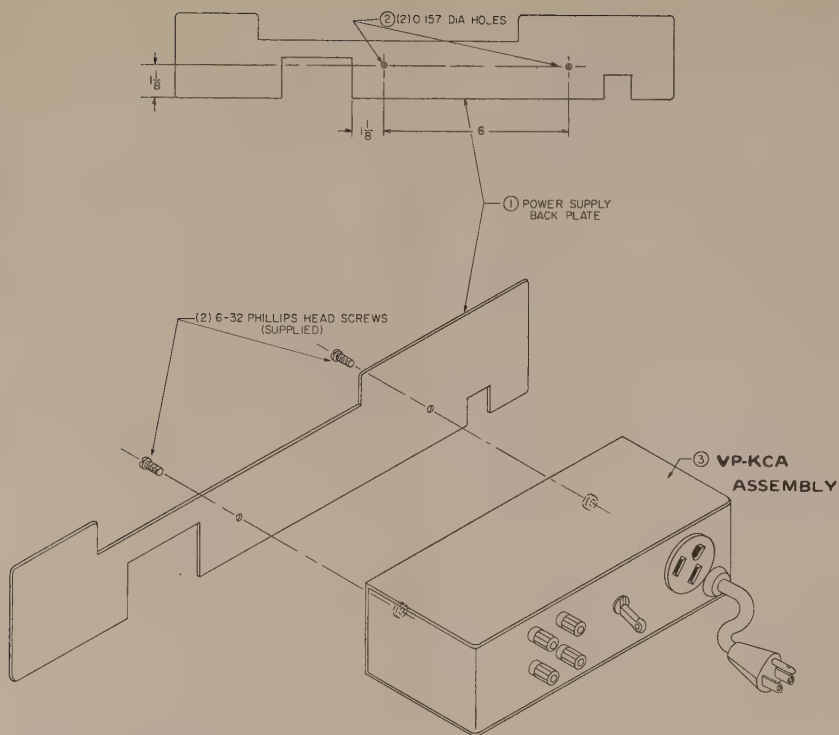
SECTION II - INSTALLATION

2-1 UNPACKING AND INSPECTION

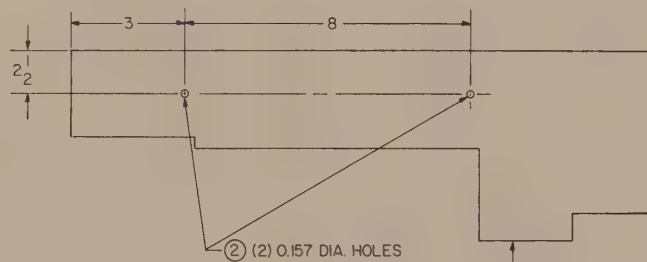
- 2-2 The Kepco Overvoltage Protector (VP) has been completely tested and inspected at the factory prior to packing and is ready for installation and operation. It should be unpacked with reasonable care and inspected for shipping damage. Notify the responsible carrier if any evidence of such damage exists.

2-3 INSTALLATION

- 2-4 All Kepco Model Overvoltage Protectors (VP) are supplied with the necessary mounting hardware contained in the polyethylene bag delivered with each unit. Follow the installation procedure as described and illustrated in FIG. 2-1.



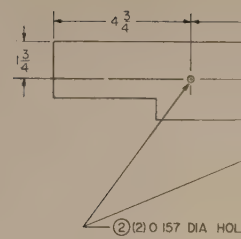
APPLICABLE FOR THE FOLLOWING
MODELS: KS8-15M, KS18-10M, KS36-5M, KS60-2M AND KS120-1M.



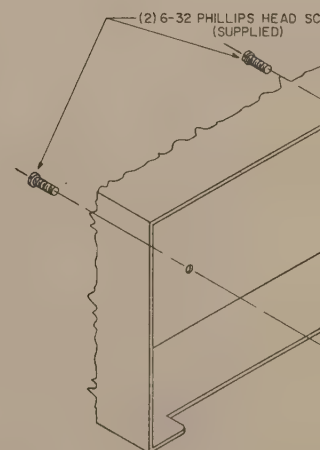
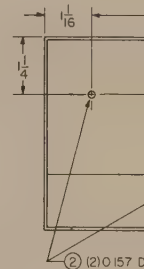
APPLICABLE FOR THE FOLLOWING MODELS: KS36-30M, KS60-20M, KS120-10M (VP-KS1); KS8-100M, KS18-50M, KS8-50M (VP-KS2).*

* NOTE: AC POWER LINE-PLUG ON THIS MODEL MUST BE REPLACED WITH A 30A, "HUBBEL-TWIST LOCK" PLUG OR EQUIVALENT.

VP-K/13-68



APPLICABLE FOR THE FOLLOWING
MODELS: KS8-25M, KS18-15M, KS36-10M, KS60-5M AND KS120-2.5M



APPLICABLE FOR ALL ABC MODELS EXCEPT ABC HYBRID AND ALL

SECTION III - OPERATION

3-1 INITIAL ADJUSTMENTS AND TEST

3-2 The static trigger level controls (COARSE and FINE) on the VP Overvoltage protectors are factory adjusted to their maximum operating range (30 volts or 160 volts respectively) and must be adjusted to the desired level before the actual load is connected to the power supply/VP combination. Connect the test set-up as shown in FIG. 3-1 or FIG. 3-2 depending on the model of overvoltage protector used. Proceed as follows:

- a) Connect power supply AC line cord to the POWER OUTLET in the VP-KCA, VP-KS1 or VP-KS2
IMPORTANT: Do not connect power supply directly to the power-line.
- b) Connect voltmeter (M1) and VP device to power supply as shown in FIG. 3-1 or 3-2.

NOTE: All Kepco power supplies have a rear barrier strip (TB1) with output and error sensing terminals as shown in FIG. 3-1. KS power supplies with high output current have additional heavy duty output terminals. THE VP-KCA AND THE LOAD MUST BE CONNECTED TO THE HEAVY DUTY OUTPUT TERMINALS, (on all KS power supplies so equipped) NOT TO TB1. On other power supplies not equipped with separate output terminals, all connections are made on the rear barrier strip (TB1)

- c) Turn POWER SUPPLY AC power switch "on". (This switch will remain "on". AC input will be switched on the VP-CIRCUIT BREAKER/POWER SWITCH). Turn POWER SUPPLY and VP "on" by means of the circuit breaker on the VP. Set POWER SUPPLY voltage to the desired level plus overvoltage. (If for example a power supply output of 40 volts is required, and shut-down is desired at 42 volts, set power supply output first to 42 volts as read-out on M1).
- d) Slowly, turn the COARSE control on the VP-KCA counter clockwise until the VP CIRCUIT BREAKER/SWITCH shuts off and the power supply output goes to zero (crowbar point).
- e) Turn power supply "Voltage Control" slightly towards decreasing voltage. Re-activate supply and VP device by re-engaging the CIRCUIT BREAKER/SWITCH on the VP.
- f) Turn power supply "Voltage Control" slowly towards increasing voltage. Observe carefully the previously adjusted crow-bar point on the voltmeter. Correct by turning the FINE control on the VP clockwise if this point is too close to the power supply operating voltage, turn counter clockwise if the crowbar point is not close enough.
- g) "Triggering Time" may be adjusted on the DELAY control.* A range of about 1:2 is provided (See specifications, paragraph 1-5d) The triggering time becomes shorter (and the sensitivity to spurious triggering greater), as the DELAY is turned counter clockwise.
- h) Once the adjustment is completed, the actual load may be connected and operation can commence.

*The DELAY ADJUSTMENT is factory adjusted for greatest sensitivity consistent with non-spurious operation of the VP. Adjustment is therefore not needed in most cases.

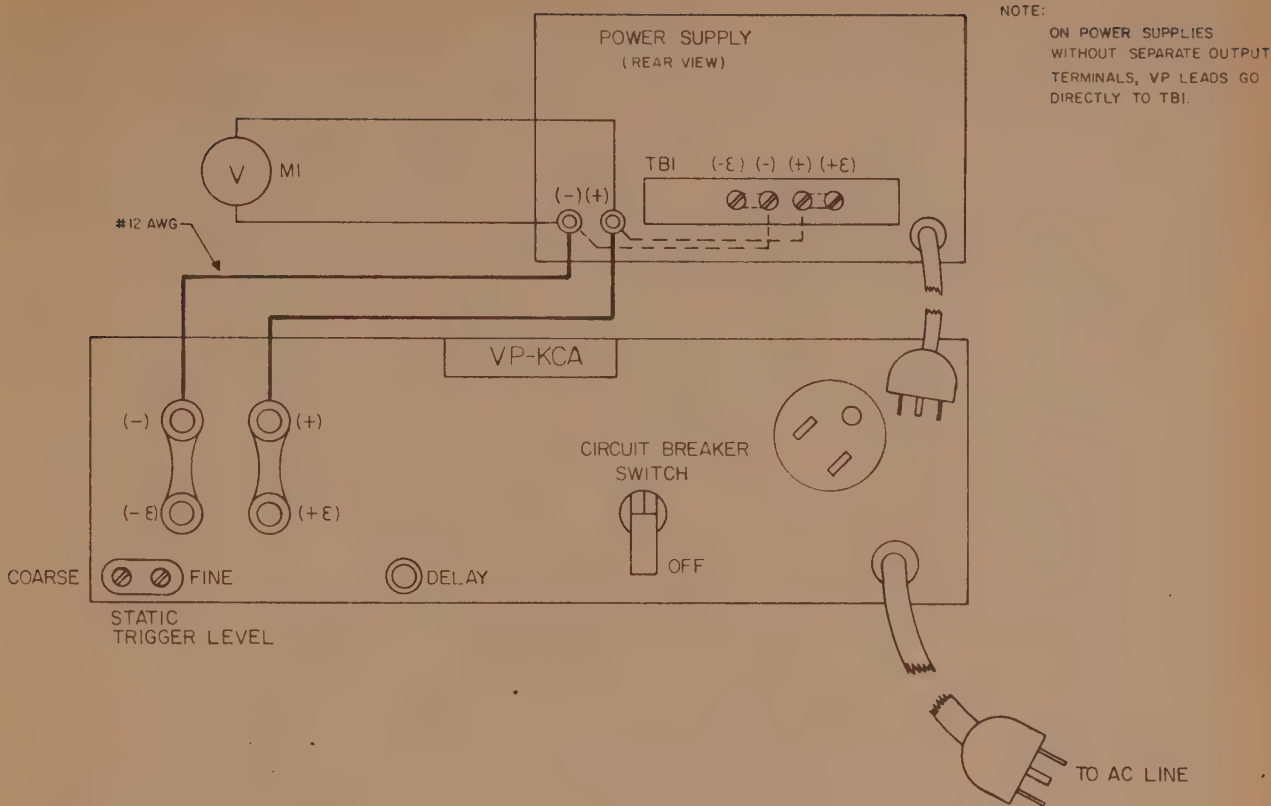


FIG. 3-1 TEST SET-UP, MODEL KCA

3-3. LOAD CONNECTION

- 3-4 For applications where the load is located close to the power supply, the load may be connected in place of the voltmeter as shown in FIG.'s 3-1, 3-2 as long as adequate diameter load-wires are used. Any load wire voltage drop will of course have to be added to the minimum static trigger level of the V.P. (Example: If a load wire drop of 0.1 volt exists per load wire, the minimum static trigger level achievable is now $0.25V + 0.1V + 0.1V = 0.45V$.) For remote load connections it is therefore best to use the remote error sensing feature which is provided in all Kepco VP devices.
- 3-5 Remove jumper links on the VP and on the power supply as indicated on FIG.'s 3-3, 3-4 and connect load as shown. Load wires should be as heavy as practicable. Error sensing leads should be at least AWG #20, twisted and shielded. Observe polarities: Positive error sensing lead must go to the positive output lead at the load.

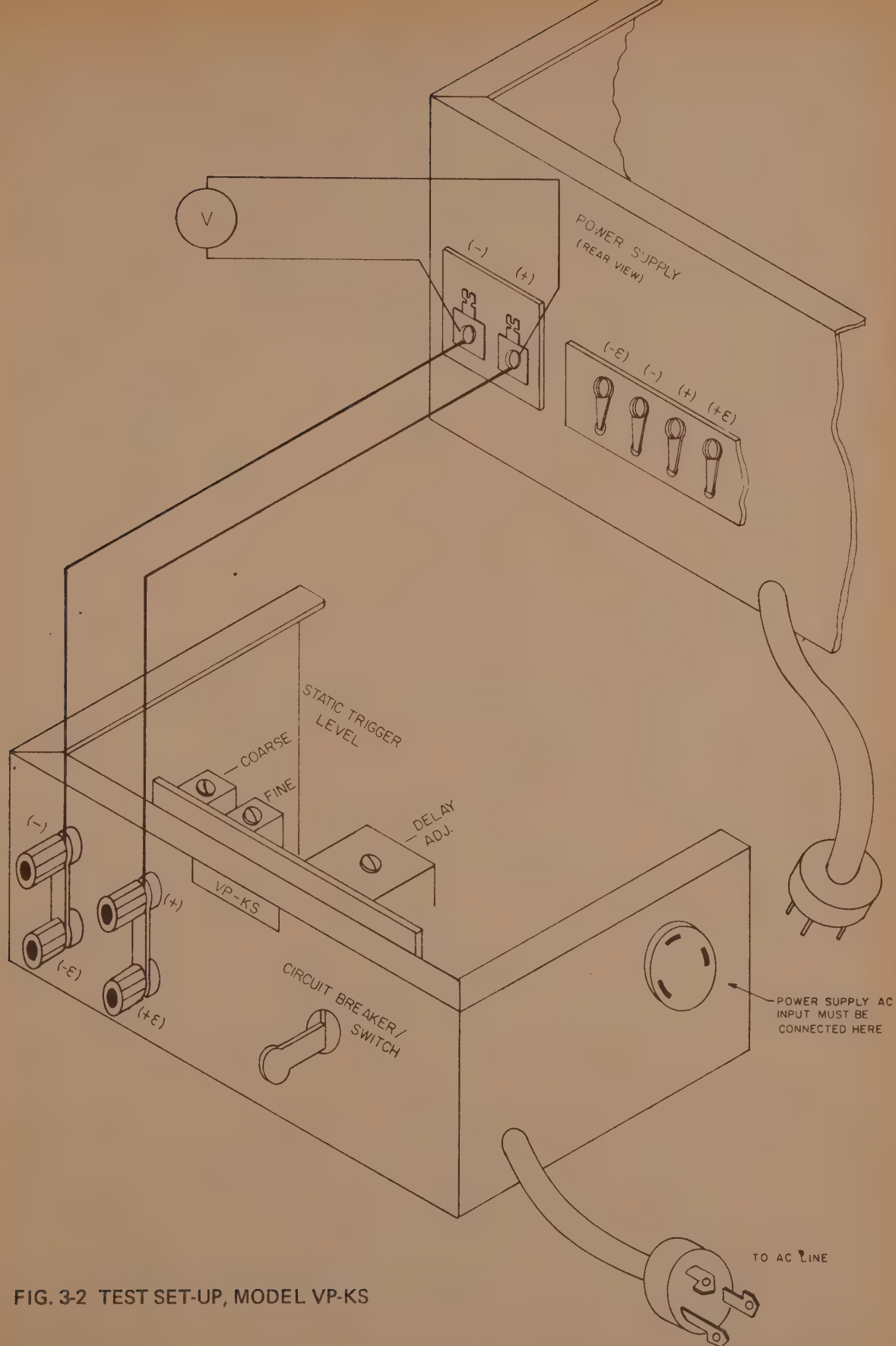


FIG. 3-2 TEST SET-UP, MODEL VP-KS

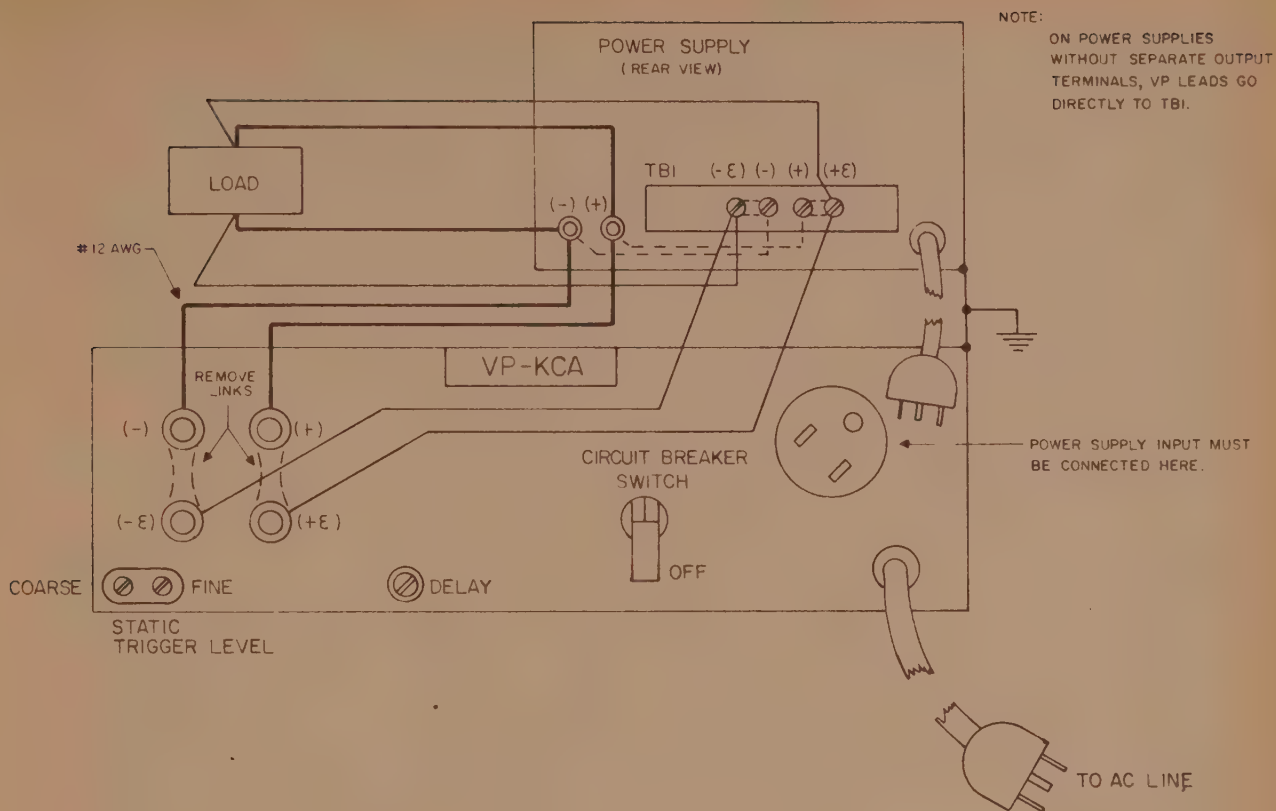


FIG. 3-3 LOAD CONNECTION WITH ERROR SENSING, VP-KCA

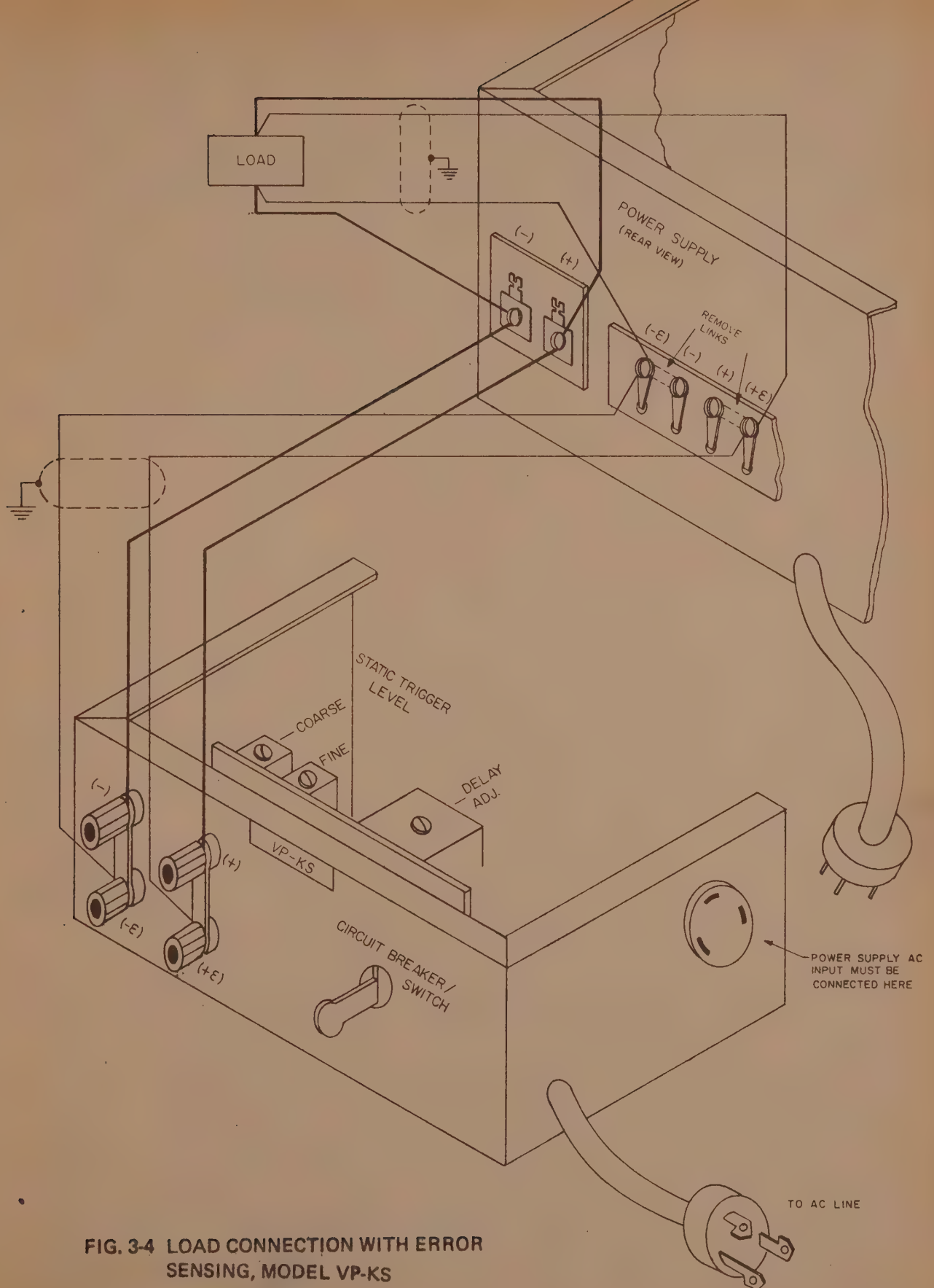


FIG. 3-4 LOAD CONNECTION WITH ERROR SENSING, MODEL VP-KS

SECTION IV - THEORY OF OPERATION

4-1 GENERAL

4-2 This section describes the major circuitry of the Kepco VP-KCA, VP-KS1 and VP-KS2 Overvoltage Protector. The purpose of the analysis is to provide the user with a functional understanding of the equipment, thus forming a basis for successful operation and maintenance.

4-3 BLOCK DIAGRAM

4-4 Circuit operation is best described by means of the block diagram.
(FIG. 4-1)

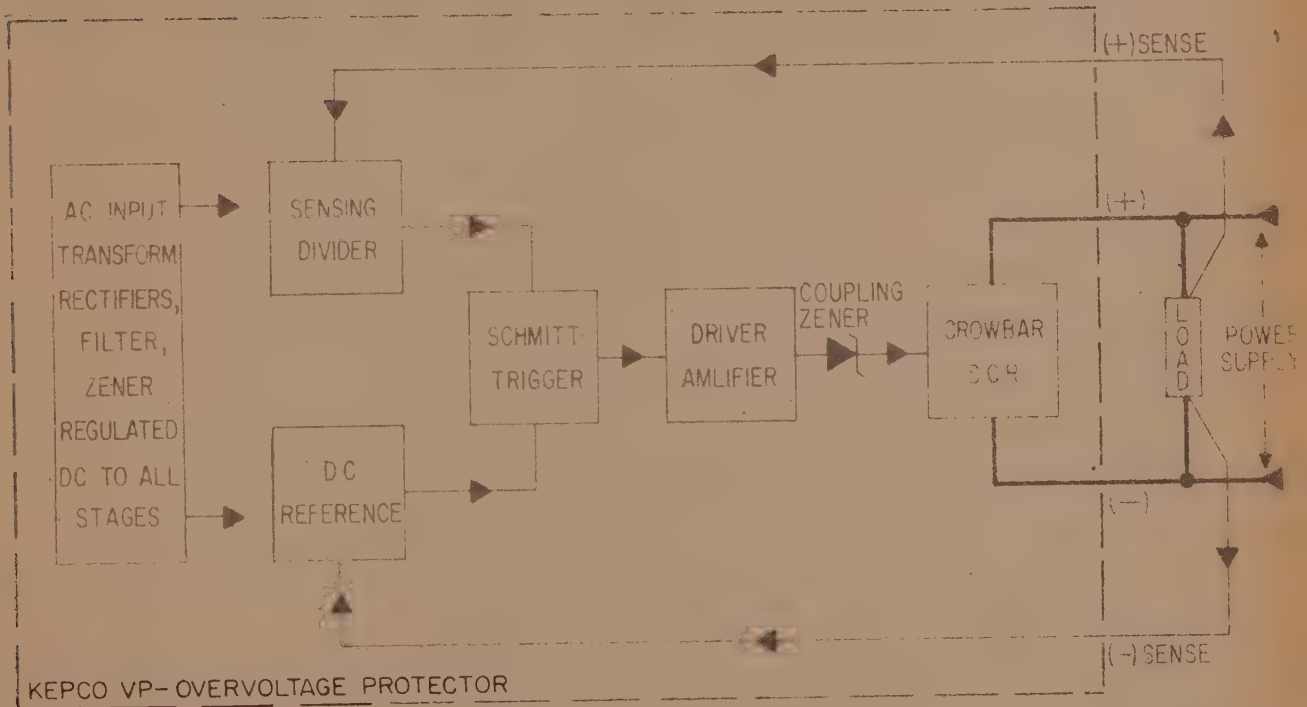


FIG. 4-1 BLOCK DIAGRAM

- The power supply output voltage is sensed across the load and connected to a DC reference voltage and a resistor divider.
- The DC reference is continuously compared to a portion of the sensing voltage. At balance the sensing voltage is less than the reference voltage minus 0.1 volt, and the circuit is inactive.

- c) Should an overvoltage occur, the divider voltage will exceed the DC reference level (minus 0.1 volt) and thereby activate the Schmitt Trigger circuit. This will turn-on the Transistor Driver/Amplifier. The amplified signal, transferred through the Coupling Zener will finally trigger the Crowbar S.C.R.

4-5 CIRCUIT DESCRIPTION (Refer to Schematic, FIG. 6-1)

- a) **AC INPUT CIRCUITRY.** AC input power is introduced through a heavy duty line cord with safety plug. The circuit breaker (CB201) performs a dual function: 1) It serves as a manual "on-off" switch for the VP and the power supply, which is connected to the POWER SUPPLY OUTLET; 2) The relay coil of CB201 drips the breaker contacts automatically once the S.C.R. "crowbars". Once CB201 is manually closed, AC input power is applied to the POWER SUPPLY OUTLET and to the VP transformer (T1). The B(+) voltage produced at the secondary of T1 has to flow through the circuit breaker coil, but will under normal operating conditions not activate the contacts. If the crowbar S.C.R. (CR201) fires however, it short-circuits the output and also places a short circuit across the B(+) supply (via CR5) of the VP. The increase in current through the circuit breaker coil will now drip the breaker contact and disconnect the power supply as well as the VP from the AC power line.
- b) **DC POWER SUPPLY.** The DC operating voltage is derived from a full wave circuit, consisting of (CR1,CR2,CR3,CR4) and a capacitor filter (C1) provide for the raw DC voltage. Zener regulator diode CR8 holds the operating voltage at a constant nominal 15 volts.
- c) **SCHMITT-TRIGGER/AMPLIFIER AND DRIVER STAGES**
The Schmitt trigger stage (Q3,Q4) functions as a voltage comparator or sampling circuit by causing Q3 to change states as the base voltage of Q4 is altered.* The collector voltage of the stage is rigidly clamped to +6.5 volts reference voltage. If the base voltage is therefore increased by a voltage signal from the divider (due to overvoltage) turn-on in the driver-stage (Q1,Q2) results in a positive signal to the coupling zener diode (CR6) and the gate of crowbar S.C.R. (CR201).
- d) **CROWBAR CIRCUIT.** The crowbar S.C.R. is connected directly across the output of the power supply, providing a short circuit once the device is turned on by the action described above. Another short circuit is placed across the B+ supply via CR5, causing the circuit breaker CB201 to "fall out" and remove AC power from both, power supply and VP circuitry. The VP is re-adjusted by turning its circuit breaker "on", once the cause for overload has been removed.

*C_T is an adjustable trim capacitor determining the charging time constant at the output of the Schmitt-Trigger Stage which may be controlled over range of approximately 1:2.

SECTION V - MAINTENANCE

5-1 GENERAL

- 5-2 Conservative component rating and uncongested layout in the Kepco Overvoltage protectors should keep maintenance problems to a minimum. If component failure should take place however, all parts are easily accessible and quickly identified by means of the component location drawing (FIG. 5-2) and the parts list (Section VI).

5-3 PRECAUTIONS

- 5-4 No parts in this device should be replaced with substitutes not specified in the parts list. No adjustments or circuit changes must be made other than those described in this Manual. Substitution of parts not specified or unauthorized circuit changes made without understanding the effects, may cause serious damage to the VP device, the associated power supply or the connected load.

5-5 FUNCTIONAL TEST

- 5-6 Incoming inspection, or service personnel after repair, may have to test the VP before it is permanently installed and connected to the power supply. Since the VP has its own power transformer, this is readily accomplished by referring to FIG. 5-1 and following the procedure given below.

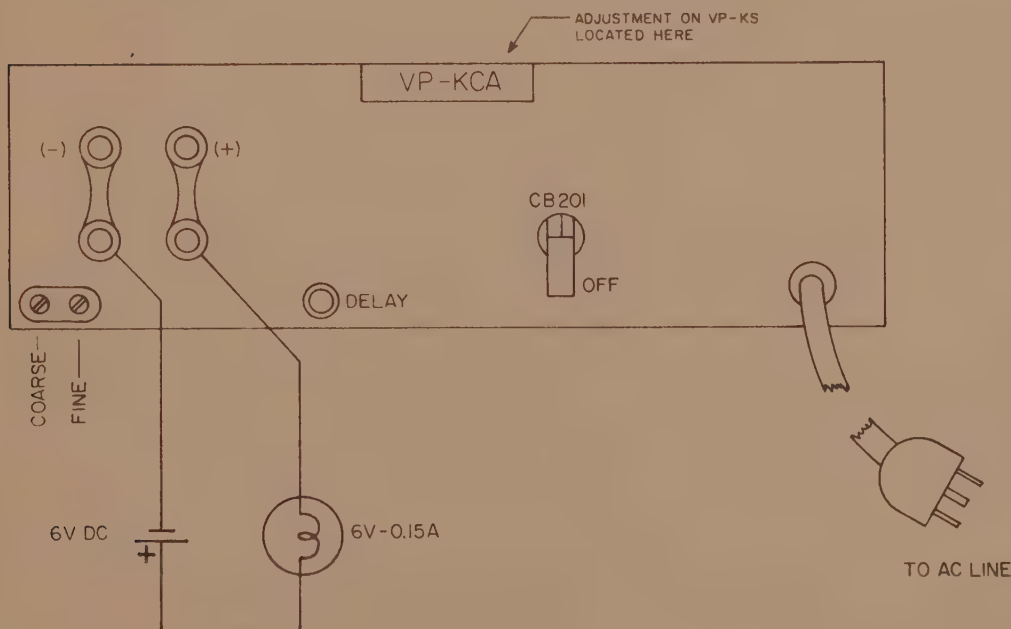


FIG. 5-1 CONNECTIONS FOR FUNCTIONAL TEST

5-7 PROCEDURE, VP CHECK-OUT

a) EQUIPMENT REQUIRED

1) DC supply with crow-bar indicator (battery with an incandescent bulb is sufficient).

b) Connect VP to the power line and turn CB201 "on".

c) Slowly turn COARSE control counter clockwise. As the battery voltage is reached, the VP should crowbar, indicated by the momentary flashing of the crowbar indicator and the subsequent shut-down of the circuit breaker. This concludes the functional test.

PRINTED CIRCUIT BOARD ASSY
(SEE FIG. 5-2 FOR DETAIL)

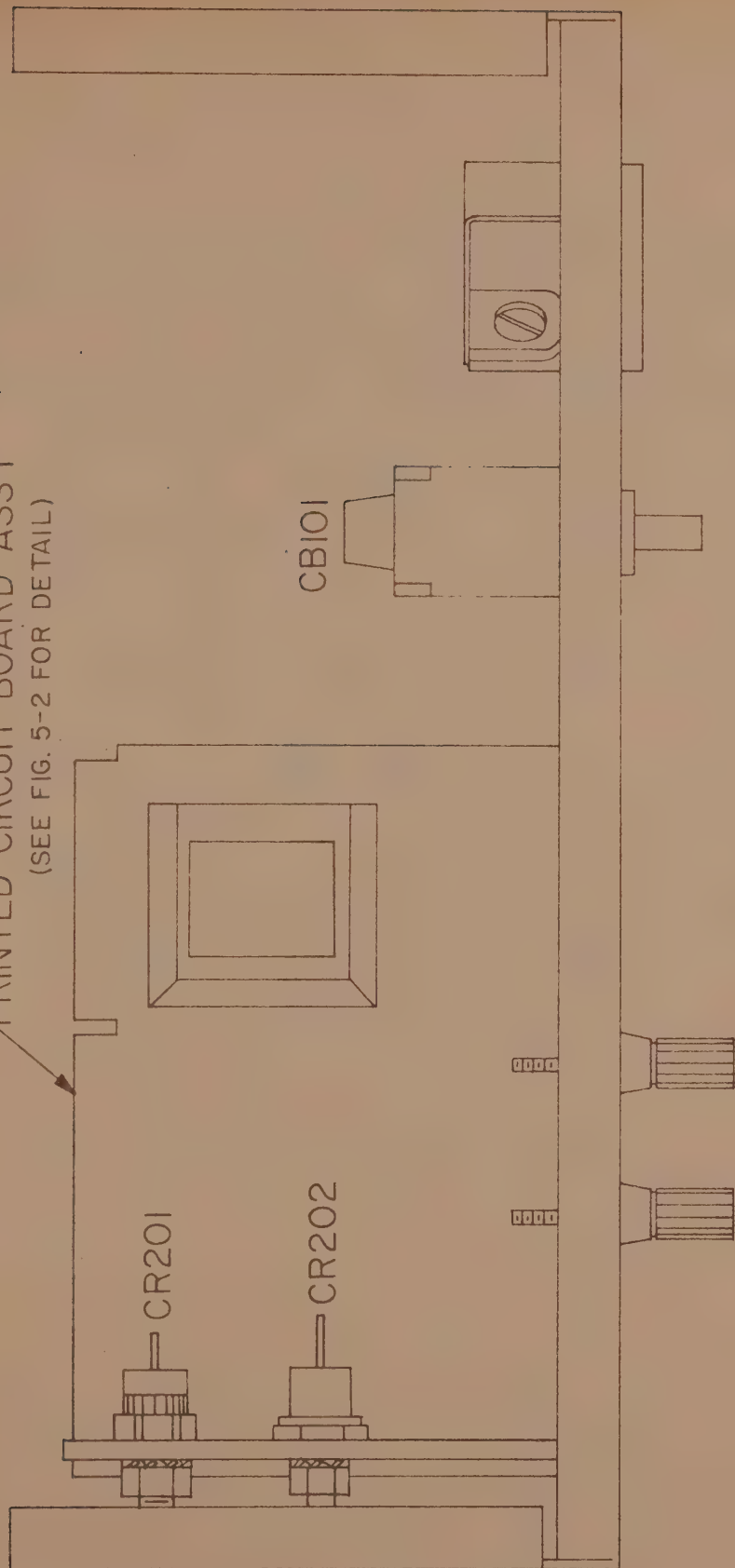


FIG. 5-2 COMPONENT LOCATION, MAIN CHASSIS

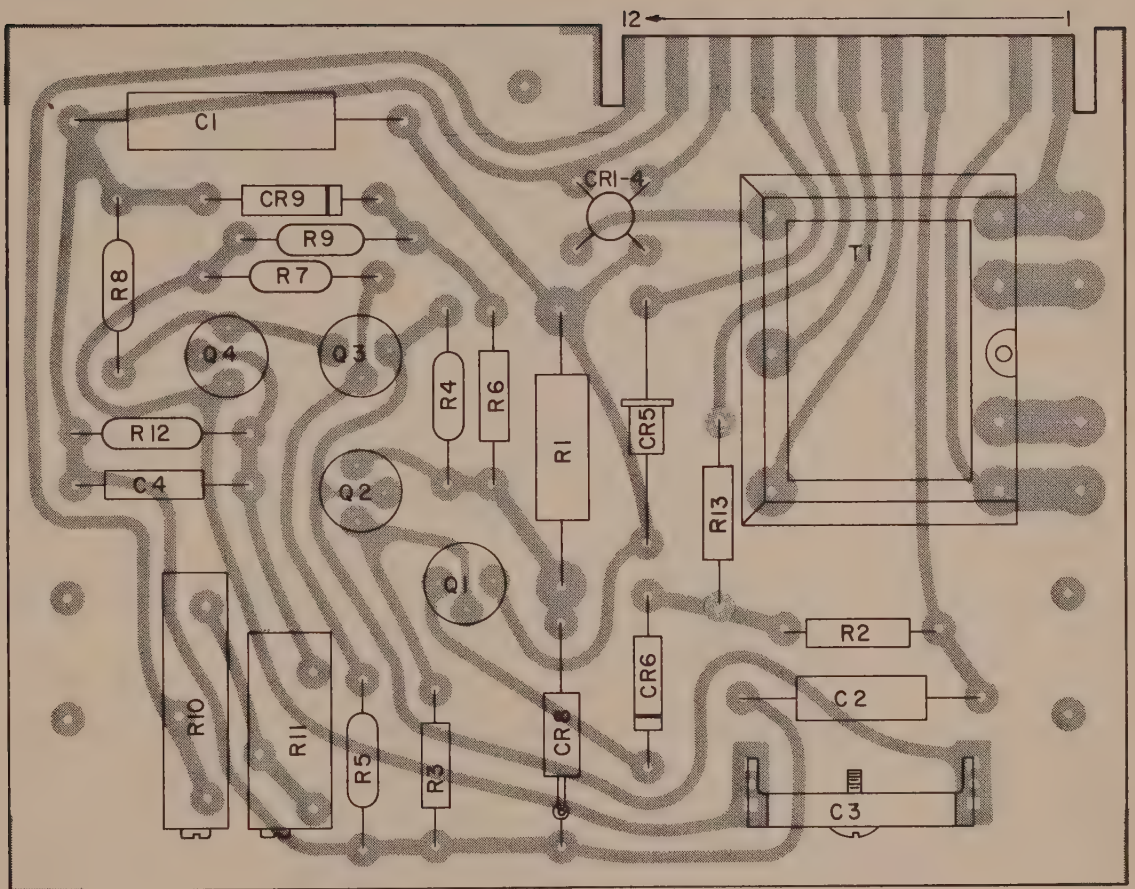


FIG. 5-3 COMPONENT LOCATION (PCB)

SECTION VI — ELECTRICAL PARTS LIST AND SCHEMATIC

6-1 GENERAL

- 6-2 This section contains the main schematic with a listing of all replaceable electrical parts. All parts are listed in alpha-numerical order to their reference designations. Consult your Kepco Representative for replacement of mechanical parts.

6-3 ORDERING INFORMATION

- 6-4 To order a replacement part or to inquire about parts not listed in the parts list, address order to inquiry either to your authorized Kepco Sales Representative or to:

Kepco, Inc.
131—38 Sanford Avenue
Flushing, N.Y. 11352

- 6-5 Specify the following information for each part:

- a) Model and complete serial number of instrument.
- b) Kepco part number.
- c) Circuit reference designator.
- d) Description.

- 6-6 To order a part not listed in the parts list, give a complete description and include its function and location.

MODEL VP-KCA OVERVOLTAGE PROTECTOR

Code 3-2668

SCHEMATIC NO.	QTY.	DESCRIPTION	MFRS. NAME & PART NO. (See Note)	KEPCO PART NO.
---------------	------	-------------	-------------------------------------	----------------

PRINTED CIRCUIT BOARD ASSEMBLY CONTAINS:

C1	1	Capacitor,Electrolytic,Pigtail 50 μ F, 50 V, 20%	Sprague 30D506G050DD2	117-0658
C2	1	Capacitor,Mylar,Pigtail 0.05 μ F, 200 V	TRW X663F	117-0315
C3	1	Capacitor,Variable 80 - 480 pF, 175 V	Arco PC46	117-0637
C4	1	Capacitor,Mylar,Pigtail 6800 pF, 200 V	TRW 663-UW	117-0552
CR1,2,3,4	1	Rectifier,Silicon,Bridge	Varo EBR-W102	124-0346
CR5	1	Rectifier,Silicon,Pigtail	Semicon SM-110	124-0133
CR6,9	2	Zener Diode, Pigtail	Transitron 1N763-1	121-0028
CR8	1	Zener Diode, Pigtail	Motorola 1N3024-B	121-0057
Q1	1	Transistor,Silicon,NPN	RCA 2N3053	119-0059
Q2,3,4	3	Transistor,Silicon,NPN	General Electric 2N336A	119-0056
R1	1	Resistor,Fixed,Molded 330 ohm, 2 W, 5%	Allen Bradley HB3315	115-0882
R2	1	Resistor,Fixed,Molded 1 K ohm, 1/4 W, 10%	IRC GBT 1/4	115-2238
R3	1	Resistor,Fixed,Molded 47 K ohm, 1/4 W, 10%	IRC GBT 1/4	115-2237
R4	1	Resistor,Fixed,Precision,M.F. 6.04 K ohm, 1/4 W, 1%	IRC CEA Type	115-2175
R5	1	Resistor,Fixed,Precision,M.F. 1.1 K ohm, 1/4 W, 1%	IRC CEA Type	115-2176
R6	1	Resistor,Fixed,M.G. 1 K ohm, 1/4 W, 5%	IRC RG 1/4	115-2188
R7	1	Resistor,Fixed,Precision,M.F. 1.5 K ohm, 1/4 W, 1%	IRC CEA Type	115-2178
R8	1	Resistor,Fixed,Precision,M.F. 210 ohm, 1/4 W, 1%	IRC CEA Type	115-2177
R9	1	Resistor,Fixed,Precision,M.F. 3.92 K ohm, 1/4 W, 1%	IRC CEA Type	115-2179

REPLACEMENT PARTS MAY BE ORDERED FROM KEPCO, INC. ORDERS SHOULD INCLUDE KEPCO PART NUMBER AND DESCRIPTION.

PLEASE NOTE: THE MANUFACTURER'S NAME AND PART NUMBER LISTED FOR EACH ITEM ON REPLACEMENT PARTS LISTS, REPRESENTS AT LEAST ONE SOURCE FOR THAT ITEM AND IS LISTED SOLELY FOR THE CONVENIENCE OF KEPCO EQUIPMENT OWNERS IN OBTAINING REPLACEMENT PARTS. LOCALLY WE RESERVE THE RIGHT TO USE EQUIVALENT ITEMS FROM ALTERNATE SOURCES. KEPCO, INC.

MODEL VP-KCA OVERVOLTAGE PROTECTOR

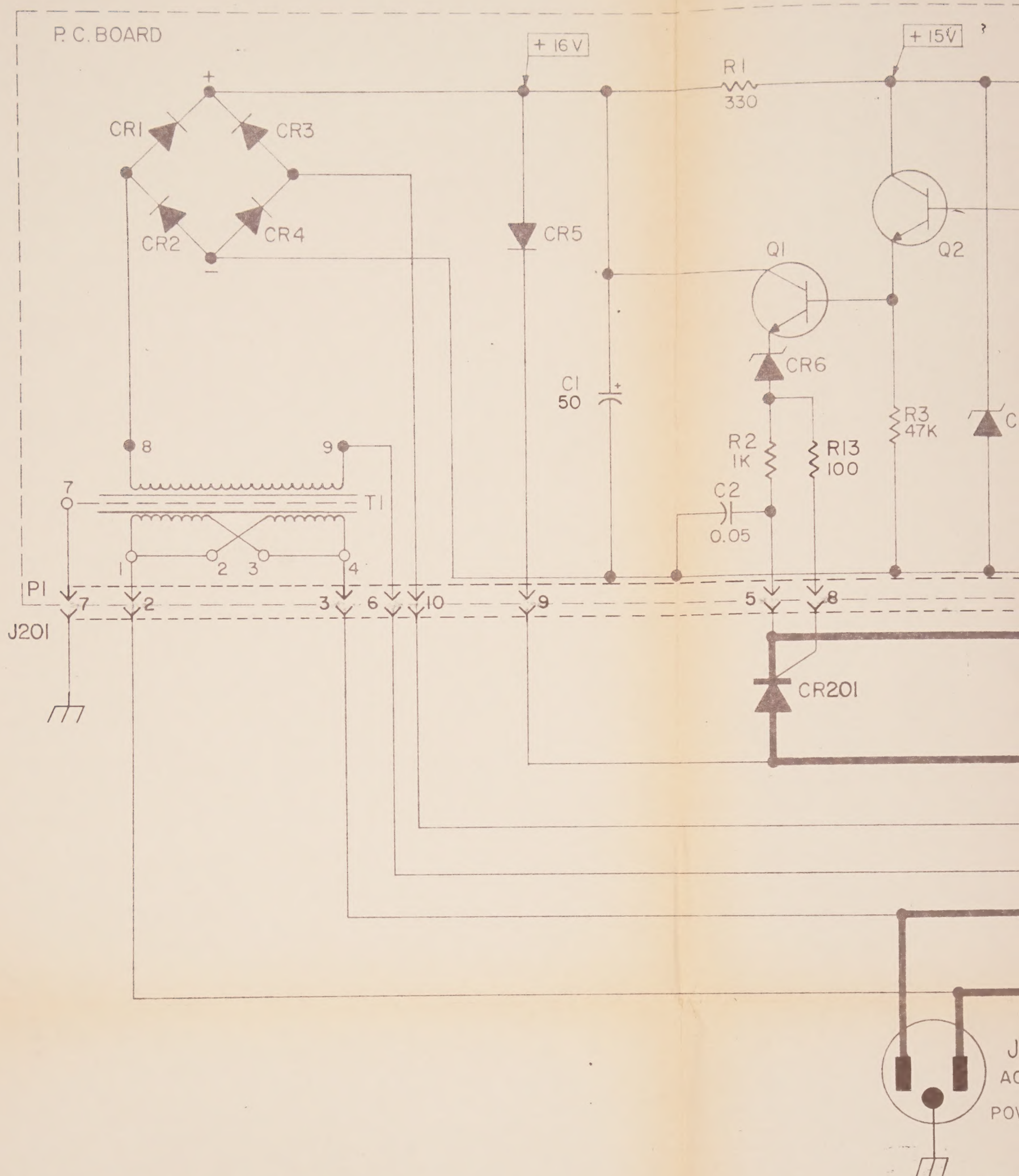
Code 5-368

SCHEMATIC NO.	QTY.	DESCRIPTION	MFRS. NAME & PART NO. (See Note)	KEPCO PART NO.
R10	1	Resistor, Variable, Cermet 2 Megohm, 3/4 W, 20%	Helipot 78PR2Meg.	115-2048
R11	1	Resistor, Variable, WW 20 K ohm, 1/2 W	Bourns 3067P-1-203	115-1728
R12	1	Resistor, Fixed, Precision, M.F. 10 K ohm, 1/4 W, 1%	IRC CEA Type	115-2174
T1	1	Transformer	Kepco Magnetics	100-1743

MAIN CHASSIS ASSEMBLY CONTAINS:

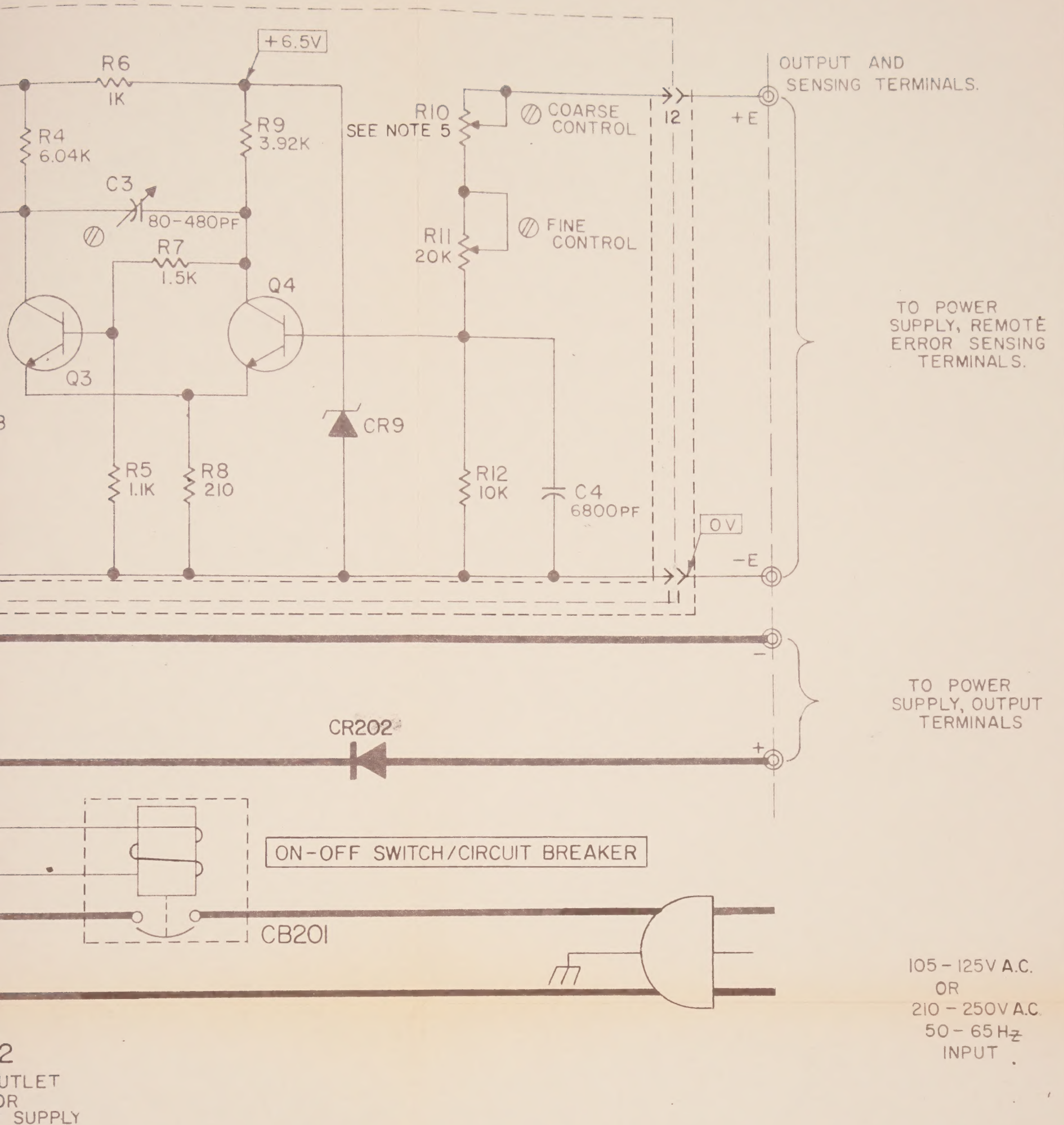
CB201	1	Circuit Breaker	Heineman Electric JA1-A6	127-0263
CR201	1	Rectifier, Silicon, Control	General Electric C30B	124-0268
CR202	1	Rectifier, Silicon, Stud	International Rectifier 60HE15	124-0351

REPLACEMENT PARTS MAY BE ORDERED FROM KEPKO, INC. ORDERS SHOULD INCLUDE KEPKO PART NUMBER AND DESCRIPTION.
PLEASE NOTE: THE MANUFACTURER'S NAME AND PART NUMBER LISTED FOR EACH ITEM ON REPLACEMENT PARTS LISTS REPRESENTS AT LEAST ONE SOURCE FOR THAT ITEM AND IS LISTED SOLELY FOR THE CONVENIENCE OF KEPKO EQUIPMENT OWNERS. IN OBTAINING REPLACEMENT PARTS LOCALLY WE RESERVE THE RIGHT TO USE EQUIVALENT ITEMS FROM ALTERNATE SOURCES. KEPKO, INC.

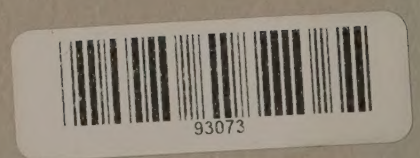


NOTES:

1. RESISTOR VALUES IN OHMS, K=1000.
2. CAPACITOR VALUES IN MICROFARADS, EXCEPT WHERE INDICATED OTHERWISE.
3. VOLTAGE READINGS IN RESPECT TO (-) ERROR SENSING TERMINAL UNDER THESE CONDITIONS.
 - A) UNIT CONNECTED TO POWER SUPPLY AND AT BALANCE (SCR NOT FIRED).
 - B) INSTRUMENT 20K OHMS/V.
 - C) MEASUREMENTS SUBJECT TO COMPONENT TOLERANCES.
4. J201, PINS 1, 4 NOT USED
5. RIO IS 2 MEG OHM IN MODEL VP-KCA AND VP-KSI
RIO IS 500 K OHM IN MODEL VP-KS2



KEPCO INC. FLUSHING, N.Y.			
TITLE SCHEMATIC			
DRAWN E.L.	CHECKED [Signature]	APPROVED [Signature]	DATE 3-26-68
MODEL NO. VP-KCA VP-KSI VP-KS2		PART NO. FIG. 6-1	SCALE NONE
DWG. NO. CM07563			



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